Entergy

Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
295 Broadway, Suite 1
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September 1, 2005

Re: Indian Point Units No. 2 and 3
Docket Nos. 50-247 and 50-286
NL-05-094

Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Stop O-P1-17
Washington, DC 20555-0001

SUBJECT: Response to NRC Generic Letter 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors

References:
1. NRC Generic Letter 2004-02, "Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors", dated September 13, 2004.
2. NL-05-023, "90-Day Response to NRC Generic Letter 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors", dated February 28, 2005.

Dear Sir:

This letter provides Entergy Nuclear Operations (Entergy), Inc. response to NRC Generic Letter (GL) 2004-02 (Reference 1) for Indian Point Unit 2 and Indian Point Unit 3. The information requested by the Generic Letter is provided in Attachment 1.

Attachment 2 provides an update to commitments made by Entergy in the 90-Day response to the subject generic letter (Reference 2). No new commitments are being made in this submittal. If you have any questions or require additional information, please contact Mr. Patric W. Conroy, Licensing Manager at 914-734-6668.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 9/1/2005.

Sincerely,

For.

Fred R. Dacimo
Site Vice President
Indian Point Energy Center

cc: next page

A116

Attachment 1: Indian Point Unit 2 and Unit 3 Response to NRC Generic Letter 2004-02
Attachment 2: Indian Point Unit 2 and Unit 3 Update to Commitments made in the 90-Day Response

cc:

Mr. John P. Boska, Senior Project Manager
Project Directorate I,
Division of Licensing Project Management
U.S. Nuclear Regulatory Commission

Regional Administrator
Region I
U.S. Nuclear Regulatory Commission

Resident Inspector's Office
Indian Point IP 2
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Mr. Paul Eddy
NYS Department of Public Service

INDIAN POINT UNIT 2 and UNIT 3

ATTACHMENT 1 TO NL-05-094

Response to NRC Generic Letter 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors

ENTERGY NUCLEAR OPERATIONS, INC
INDIAN POINT NUCLEAR GENERATING UNITS 2 AND 3
DOCKETS 50-247 AND 50-286

Response to NRC Generic Letter 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors

Addressees are requested to provide the following information no later than September 1, 2005:

Requested Information Item 2(a):

Confirmation that the ECCS and CSS recirculation functions under debris loading conditions are or will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. This submittal should address the configuration of the plant that will exist once all modifications required for regulatory compliance have been made and this licensing basis has been updated to reflect the results of the analysis described above.

Entergy Response to Item 2(a):

The recirculation functions of the Emergency Core Cooling System (ECCS) and Containment Spray System (CSS) under debris loading conditions will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of the subject generic letter in accordance with the new regulatory guidance. In order to ensure compliance, Entergy has performed and continues to perform analyses to determine the susceptibility of the ECCS and CSS recirculation functions to adverse effects of post-accident debris blockage and operation with debris-laden fluids. The analyses to date conform to the greatest extent practicable to the NEI 04-07 Guidance Report methodology (NEI GR)(Ref. 1) as supplemented by the NRC Safety Evaluation Report (NRC SER)(Ref. 2). (Refer to response to Item 2(c) for further information).

The following major activities have been completed:

- Containment walkdowns and surveillances with the exception of latent debris sampling for Unit 2
- Vendor debris generation analyses
- Vendor post-accident containment water level calculations

The following activities are currently in progress:

- Formal acceptance of completed vendor calculations
- Available Net Positive Suction Head (NPSH) analysis
- Entergy review of vendor debris transport analysis
- Entergy review of vendor downstream effects evaluations
- Development of conceptual design options
- Entergy review of vendor debris head loss evaluations (sump screen surface area determinations)
- Selection of the final design

- Selection of sump screen hardware vendor

The following activities are currently in planning:

- Assessment of margin to address chemical effects
- Programmatic and procedural changes
- Confirmatory latent debris sampling for Unit 2

Based on the work performed to date, modifications will be required to both the recirculation and containment sumps and associated screens. The Unit 3 Internal Recirculation (IR) pumps will be replaced to match the Unit 2 design in order to reduce the required net positive suction head. In addition, modifications may be required in order to reduce the amount of debris migrating to the sumps. These modifications may include the addition of flow channeling including flow diversion barriers/new crane wall openings, debris interceptors, selected installation of insulation jacketing and missile/jet impingement barriers.

The recirculation sumps at both Unit 2 and Unit 3 are of a sufficient size to accommodate replacement screens with large surface areas. The containment sumps are considerably smaller, particularly for Unit 2. In order to address the issues associated with the relatively small Unit 2 containment sump Entergy is currently evaluating analysis, design and licensing basis options. These options are discussed further in the responses to Items 2(c) and 2(d)(iii).

Preliminary results indicate that the upper and lower bearings of the Internal Recirculation (IR) pumps may be affected by debris. Preliminary results also indicate that the fibrous debris that passes through the sump screens may collect to form a thin fiber bed below the core for certain primary system break locations. Resolution of these potential downstream issues may require equipment modifications and/or the use of an alternate evaluation approach as discussed further in the response to Item 2(c).

Following selection of the final design option, which will provide resolution to the above issues, detailed engineering in support of the modification will commence. This detailed engineering will include sump screen structural analysis, consistent with industry accepted practices and applicable regulatory guidance. The analyses completed to date or in process may be affected by the final design resolution of the sump screen blockage issues. These analyses will be revised as required to represent the final design.

Licensing basis changes will be required as a result of analyses or plant modifications made to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of the subject generic letter. Should a License Amendment Request (LAR) be required it will be submitted to the NRC by December 31, 2005. The potential for a LAR is further discussed in the response to Item 2(e).

Requested Information Item 2(b):

A general description of and implementation schedule for all corrective actions, including any plant modifications, that you identified while responding to this generic letter. Efforts to implement the identified actions should be initiated no later than the first refueling outage starting after April 1, 2006. All actions should be completed by December 31, 2007. Provide justification for not implementing the identified actions during the first refueling outage starting after April 1, 2006. If all corrective actions will not be completed by December 31, 2007, describe how the regulatory requirements discussed in the Applicable Regulatory Requirements section will be met until the corrective actions are completed.

Entergy Response to Item 2(b):

The response to 2(a) provided a list of completed, in progress and planned activities needed to address the subject generic letter. The following design and related actions, as determined to be required, are scheduled for completion prior to refueling outages 2R17 and 3R14 for Unit 2 and Unit 3 respectively, but not later than December 31, 2007. Currently 2R17 is scheduled for April, 2006 and 3R14 is scheduled for March, 2007.

- Available Net Positive Suction Head (NPSH) analysis
- Debris transport analysis
- Downstream effects evaluation
- Development of conceptual design options
- Determination of debris head losses (sump screen surface areas)
- Selection of the final design
- Selection of sump screen hardware vendor
- Design and structural analysis of replacement sump screens
- Design and structural analysis of debris interceptors and flow diversion barriers
- Design of missile/jet impingement barriers
- Design of insulation jacketing
- Assessment of margin to address chemical effects
- Procedural revisions and enhancements
- Programmatic revisions and enhancements

The selection of the sump screen vendor is in progress and will be completed shortly. The debris transport and downstream effects evaluations are also nearing completion. An update of these activities will be submitted to the NRC by December 15, 2005.

The replacement of the sump screens and attendant modifications are currently scheduled to be completed during refueling outages 2R17 and 3R14.

The following items have currently been identified as activities that may require additional evaluation or additional testing to confirm or validate various assumptions used in the sump evaluation methodology. These activities are discussed further in other sections of this response:

- Chemical effects testing
- Downstream effects evaluation
- Scanning Electron Microscope (SEM) test for asbestos containing thermal insulation
- Zone of Influence (ZOI) testing for qualified coatings
- Strainer debris bypass fraction test
- Strainer head loss performance test including thin bed invulnerability demonstration
- Debris interceptor performance test

The following key activities and/or predecessors that could impact final design and planned installation are:

- Chemical effects testing results
- Results of the downstream effects evaluation on the fuel and system components
- Results of evaluations associated with the Unit 2 containment sump
- Final design selection and hardware delivery

Entergy intends to complete all design, procurement, fabrication, delivery and installation of replacement sump screens and attendant modifications that will meet or exceed all applicable regulatory requirements for post-accident sump performance by startup from the 2R17 and 3R14 outages, but no later than December 31, 2007.

As noted above, a number of challenges exist with respect to the need for additional analyses, testing and key activities/predecessors, most notably issues associated with the Unit 2 containment sump related to its small size and the downstream effects evaluation for the fuel.

As indicated above, Entergy will supplement this response by December 15, 2005 to provide an updated status of the requested information.

<u>Requested Information Item 2(c)</u>:

A description of the methodology that was used to perform the analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage and operation with debris-laden fluids. The submittal may reference a guidance document (e.g., Regulatory Guide 1.82, Rev. 3, industry guidance) or other methodology previously submitted to the NRC. (The submittal may also reference the response to Item 1 of the Requested Information described above. The documents to be submitted or referenced should include the results of any supporting containment walkdown surveillance performed to identify potential debris sources and other pertinent containment characteristics.)

Entergy Response to Item 2(c):

Each of the containments of the Indian Point Units comprises three main floor levels: an operating floor at El. 95'; an intermediate floor at El. 68'; and a basement floor at El. 46' that contains the reactor cavity and two sumps; the recirculation sump and the containment sump. Gratings on the floors at El. 95' and 68' provide paths for the flow of water from the higher levels of the containment to the sumps.

The two sumps for each of the Units are independent of each other. The recirculation sump serves the two 100% capacity IR pumps, which are the preferred source of cooling in the recirculation phase of an accident. The containment sump serves as a backup to the recirculation sump, and feeds two 100% capacity Residual Heat Removal (RHR) pumps located outside containment. The containment sump is not placed in service unless the IR pumps, or associated flowpaths, are unavailable. The two sumps are at the same floor elevation but in different quadrants of containment.

The primary safety concerns regarding long term recirculation cooling following a LOCA are the LOCA-generated and pre-LOCA debris materials transported to the recirculation and containment sumps. This debris can result in adverse blockage effects and post-LOCA hydraulic effects, the combination of which can have an adverse effect on the long term recirculation function. An additional concern is the impact of sump screen debris bypass on downstream components in the ECCS and CSS systems, and in the reactor vessel, during long term recirculation.

Entergy has performed and continues to perform analyses to determine the susceptibility of the ECCS and CSS recirculation functions to adverse effects of post-accident debris blockage and operation with debris-laden fluids. These analyses identified those high energy lines that, if ruptured, could require the use of ECCS and CSS recirculation, the rupture locations that produce significant quantities of debris that may challenge the recirculation function, the zone within which the break forces will be sufficient to damage materials and create debris, the amount of debris generated and the characteristics of the debris. These analyses conform to the greatest extent practicable to the NEI GR (Ref. 1) as supplemented by the NRC SER (Ref. 2). Details of these analyses are provided below.

The primary contractor for these analyses is Enercon Services. Subcontractors supporting Enercon are Westinghouse and Alion Science and Technology.

Debris Sources and Generation

A review of the accident analysis and operational procedures was performed to determine the scenarios that require ECCS or CSS to take suction from the recirculation and containment sumps. It was determined that Large Break Loss of Coolant Accidents (LBLOCAs) and certain Small Break Loss of Coolant Accidents (SBLOCAs) require sump operation. Other High Energy Line Breaks (HELBs) were considered and it was determined that sump operation for these HELBs is not required. It was also determined that the HELBs that may require recirculation are located within the crane wall inside containment.

Potential debris sources that could, in the event of a high-energy line break, challenge the performance of the recirculation and containment sump screens and ultimately the ECCS and the CSS were identified. The amount of debris generated during and following a loss of coolant accident was based on the debris sources within the containment and the location and type of pipe break. The types, quantities and locations of the potential debris sources (including insulation, coatings, and dirt/dust) were identified using plant insulation drawings, specifications and/or walkdown reports and surveillances.

The Unit 2 containment walkdowns were completed in November, 2004. These walkdowns were performed in accordance with the guidance provided in NEI 02-01 (Ref. 3). A latent debris walkdown was performed in accordance with NEI GR and the NRC SER, with the exception of a sampling survey for dust, dirt, and lint. In the absence of this sample, the Unit 3 latent debris quantities were assumed to be applicable to Unit 2. This assumption will be verified during a confirmatory Unit 2 walkdown.

The Unit 3 containment walkdowns were completed in April, 2005. These walkdowns were also performed in accordance with the guidance provided in NEI 02-01 (Ref. 3). A latent debris walkdown was performed in accordance with NEI GR and the NRC SER, and included a sampling survey for dust, dirt, and lint.

Debris Generation Analysis

Break selection consisted of determining the size and location of the HELBs that would produce significant quantities of debris and potentially challenge post-accident sump performance. The debris inventory and the transport path were examined when making this determination.

In accordance with Regulatory Guide 1.82, Rev. 3 (Ref. 4) and the NEI GR guidance report, the method used for estimating the amount of debris generated by a postulated LOCA is based on a spherical zone of influence (ZOI). Thus, the evaluation of debris generation for a given break location consisted of establishing an appropriate ZOI, mapping that ZOI volume over the spatial layout of piping and components, calculating the quantity of debris source material within that ZOI, and determining the size distribution of the debris.

The spherical ZOI was truncated whenever the ZOI intersected robust barriers. The only robust barriers considered for all of the break locations were the primary shield wall, the crane wall, the operating deck, the RHR heat exchanger/ internal recirculation pump enclosure, and other robust concrete structures. No shadowing by large components within the north and south compartments inside the containment was credited.

At Indian Point Unit 2, five types of insulation were identified inside the crane wall during the containment walkdowns: Nukon® Low Density Fiberglass (LDFG), Transco Blanket (LDFG), Temp-Mat High Density Fiberglass (HDFG), Asbestos (particulate), and Reflective Metallic Insulation (RMI). For Unit 3, eight types of insulation were identified inside the crane wall:

Calcium Silicate, Nukon® (LDFG), Mineral Wool, Temp-Mat (HDFG), Asbestos (particulate), unclassified Fiberglass, Fiber Board, and RMI.

Debris sources that may dislodge and become transportable as a result of the harsh containment environment and effects of containment sprays were also evaluated. These sources include unqualified coatings, degraded qualified coatings, tags, labels, tapes, dust, and dirt. The insulation inside the containment building contains adequate covering to prevent containment spray flow or break flow from eroding insulation that is not destroyed during the LOCA event.

The specific break locations considered include breaks that: (1) generate the largest quantity of debris, (2) generate two or more different types of debris, (3) breaks in the most direct path to the sump and (4) large breaks with the largest potential particulate debris to fiber ratio. There are many breaks that could generate a small quantity of fibrous debris that would be necessary to form the theoretical 1/8" thin bed. As a result, the strainers to be designed will require a relatively large surface area with a complex geometry. Entergy plans to install replacement strainers with demonstrated invulnerability to development of a thin fiber bed.

Debris generation analyses were performed for the Baseline Analyses utilizing the debris specific ZOIs, in accordance with the NEI GR as supplemented by the NRC SER. Additionally, Analytical Refinement Analyses were performed considering ZOI size reductions and refined characterization of the generated debris. The debris generation analyses for the base and the refinement cases are described below.

Debris Generation (Baseline Analyses)

Baseline debris generation analyses were performed using the methodology, destruction pressures and ZOIs provided in the NRC SER and NEI GR. For materials for which specific data is not provided in the NEI GR, this analysis considers the destruction pressures and ZOI for the most limiting or comparable material. Additionally, the most limiting size distribution is considered for these materials.

For instance, a recommended destruction pressure and ZOI for asbestos insulation is not provided in the NEI GR. Therefore, the asbestos type insulation was assumed to have destruction properties equivalent to the NEI GR category having the lowest destruction pressure (ZOI=28.6D). The destroyed insulation inside the ZOI was assumed to fail as 100% fines.

For the baseline analyses, the large quantity of potentially adverse debris generated and the amount of debris expected to be transported to the sump has the potential to challenge the largest replacement strainers that can be located in the recirculation and containment sumps. Therefore, in order to more accurately predict a reduced amount of debris generated, analytical refinement analyses were performed.

Debris Generation (Analytical Refinement Analyses)

The quantity of transportable debris from the LOCA can be reduced by application of analytical refinements in the form of increased destruction pressures (reduced ZOI) and refined characterization of generated debris. The specific refinements, the corresponding effect on debris generation, and the specific activities required to implement these refinements are discussed below.

(a) The size distributions for LDFG and HDFG Insulation Debris were based on an Alion Science and Technology proprietary analysis that provides refinements to the NEI GR methodology for determining size distributions for fiberglass materials. NRC SER Section 4.2.4 suggests that the LOCA generated fibrous insulation debris could be separated into four distinct size classifications. The proprietary Alion analysis categorizes fibrous materials into fines, small pieces (< 6"), large pieces (> 6"), and intact pieces and are defined based on incremental destruction pressure zones.

(b) It was assumed that qualified coatings have a ZOI of 4D. This ZOI for qualified coatings is judged conservative based on the fact that the initial reactor coolant system pressure is significantly less than the pressures utilized to remove coatings using water-jet technology. In addition, industrial experience with water-jet technology to remove coatings requires application of a high-pressure jet at close proximity to the coated surface for extended periods of time. In contrast, the time period of blowdown for a PWR reactor coolant system due to a LBLOCA is on the order of 30 seconds and the break discharge pressure decreases over the duration of the blowdown period.

The 4D ZOI assumption for qualified coatings will require technical justification that may include specific coatings debris generation testing.

(c) It was assumed that asbestos insulation with jacketing has the same destruction properties as calcium silicate with jacketing. The NEI GR and NRC SER do not provide a recommended destruction pressure or ZOI for asbestos insulation. However, most commonly used asbestos insulation material is actually calcium silicate with asbestos fiber.

This assumption will require technical justification that may include verification testing (including Scanning Electron Microscope (SEM) examination) to demonstrate that the asbestos with jacketing has comparable characteristics as calcium silicate with asbestos fiber.

(d) It was assumed that all unqualified coatings, excepting inorganic zinc, outside of the coatings ZOI fail as chips. The size of chips or flakes was assumed to be equivalent to the smallest applied coating thickness. All coatings inside the ZOI and inorganic zinc outside the ZOI were assumed to have a 10 micron particle coating debris size.

A BWR Owner's Group (BWROG) report "Failed Coatings Debris Characterization" utilized autoclave test data gathered by the BWROG Containment Coating Committee to simulate LOCA exposure and gain insight into post-LOCA failure mechanisms. The result showed that all but the inorganic zinc paint failed as macro-sized pieces.

(e) It was assumed that stainless steel jacketing will be installed on insulated piping with asbestos with cloth. As stated in Item (c) above, it is expected that the asbestos insulation is essentially calcium silicate with asbestos fiber. Therefore, the ZOI for calcium silicate with stainless steel jacket was used in the debris generation analysis refinements.

This assumption requires the installation of steel jacketing on certain cloth covered asbestos piping insulation.

Debris Transport

Computational Fluid Dynamics (CFD) analyses are currently being performed to determine recirculation debris transport assessments. These analyses are being performed by Alion Science and Technology and Enercon Services.

The CFD model is used to determine the local fluid velocities and turbulence levels in the post-LOCA containment pool, as the recirculation water flows from the broken pipe and containment sprays to the sump strainers. The fluid velocities and turbulence levels are indicative of the ability of assorted sizes and types of debris to settle in the flow field. Areas with low velocities allow smaller debris sizes to settle, while larger velocities and/or turbulence levels indicate areas where debris may remain in suspension or roll along the floor and consequently, be more readily transportable to the sump.

The CFD results show that coolant discharged from the break and the containment sprays flows directly to the sumps. Any debris dispersed along the containment floor within the crane wall has a high potential for transport to the sumps. The large quantity of potentially adverse debris types and the debris expected to be transported to the sumps has the potential to challenge the largest replacement strainer that can be accommodated in the recirculation and containment sumps, for both the baseline and refinement debris generation cases.

Consequently, remedial actions to reduce the amount of debris transported to the sump may be warranted.

Debris Transport Reduction

In addition to the analytical refinements discussed above, reductions in debris transport can be achieved by plant configuration changes that minimize flow velocities and turbulent kinetic energy. The current containment layout is not conducive to debris settlement. Flow channeling, which involves diverting or distributing flows to reduce average velocities and turbulence levels offer a relatively efficient method for reduction of debris that is transported to the sumps.

A review of the containment layout offers a unique solution for debris reduction utilizing flow channeling by diverting break flows inside the crane wall through the reactor cavity/in-core tunnel and then towards the sumps. The reactor cavity/in-core tunnel offers an expansive area that produces velocities low enough to allow settlement of small and large debris pieces, free from the turbulence inducing break flow and containment spray effect. Additionally, debris entering the reactor cavity/in-core tunnel is not expected to erode due to the very low flow velocities within the in-core tunnel. Consequently, only fines and particulate matter may remain transportable.

In addition to flow channeling, debris interceptors provide a means for trapping entrained debris prior to reaching the recirculation and containment sump screens. The utilization of flow channeling through the reactor cavity/in-core tunnel, which eliminates the small and large debris pieces, requires that only fines and particulate debris be trapped using debris interceptors. If it is determined that debris source term reduction can be realized with use of debris interceptors, it is anticipated that debris interceptors may be located near the recirculation and containments sumps and outside the crane wall.

The CFD model will be revised, as required, to determine the debris transport during the detailed design phase for the replacement sump screens and associated modifications. Inputs will include the sump flows, the configuration of the flow channel, flow diverters, and the crane wall openings that are being considered in the proposed conceptual design.

Net Positive Suction Head and ECCS Pumps

For the IR and RHR pumps, a new analysis is currently in process that is expected to provide an increase in calculated NPSH margins. In order to determine the required strainer size, conservative NPSH margins limits, representing the debris head loss limits have been established. These debris head loss limit values, provided in Table 1, are expected to bound the recalculated NPSH margins.

The available NPSH values will be determined for a given containment flood elevation level for both LBLOCA and SBLOCA scenarios. In accordance with Regulatory Guide 1.82, Rev. 3 (Ref. 4), the calculated height of water on the containment floor did not consider quantities of water that do not contribute to the sump pool, nor that amount of water in enclosed areas that cannot be readily returned to the sump. In addition, conservative assumptions will be made regarding sump temperature and containment pressure conditions. It is expected that credit will not be taken for containment overpressure provided the replacement sump screens do not extend above the containment floor.

The IR and RHR pump NPSH margins will be determined for the most limiting pump flow rates corresponding to the limiting post accident system alignments. The Unit 3 IR pump NPSH margins will be based on the replacement IR pumps. In addition, the available NPSH will be calculated using the water level downstream of proposed new openings in the crane wall. The containment water level downstream of the new openings in the crane wall in the conceptual design is expected to have draw-down of approximately 2 inches at a sump flow rate equivalent to both IR pumps operating.

Debris Accumulation and Head Loss

The required strainer surface areas for the debris transported to the recirculation and containment sumps were estimated using the debris head loss limits provided in Table 1, to ensure that adequate NPSH margins are maintained. The industry accepted NUREG/CR-6224 correlation (Ref. 6) was used in these estimations.

The required Unit 2 strainer surface areas are estimated to be 1800 ft^2 and 1025 ft^2 for the recirculation and containment sumps, respectively. The corresponding Unit 3 strainer areas are 1350 ft^2 and 800 ft^2. These surface areas consider debris generation refinements and the transport model representing flow channeling through the reactor cavity/in-core tunnel, but do not include chemical effects. (See the Chemical Effects section below for how chemical effects are being addressed.)

Upstream Effects

The upstream effects evaluations include the completed containment flooding calculations and the ongoing CFD analyses that are being used to perform recirculation transport assessments. The containment flooding analysis considered holdup areas to minimize containment level for NPSH assessments. Such areas included the refueling cavity, operating floor, intermediate level, and other miscellaneous holdup volumes. The CFD methods are being used to determine the local fluid velocities and turbulence levels in the post-LOCA containment pool, as the recirculation water flows from the broken pipe and containment sprays to the sump strainers. A three dimensional (3-D) CAD model of the containment is used in the CFD analysis which is currently in progress and includes all significant features in the containment up to the post-LOCA containment flood level. The model includes all significant structures such as, concrete walls, structural steel, and large tanks & equipment that could impede or affect the flow of water to the sump.

Downstream Effects

An evaluation is currently being performed to assess the potential for wear, abrasion and debris clogging of flow restrictions downstream of the sump screens to ensure long term recirculation cooling and containment pressure and temperature control. Those flowpaths and components of the ECCS and CSS that are required to operate during recirculation are under evaluation. The evaluation is determining the susceptibility of those flowpaths, and components in those flowpaths, to wear and abrasion as well as obstruction due to debris that may pass through the recirculation and/or containment sump screens. These components and flow paths include, but are not limited to, containment spray nozzle openings, High Head Safety Injection (HHSI) throttle valves, coolant channel openings in the core fuel assemblies, fuel assembly inlet debris screens, ECCS pump seals, bearings, and impeller running clearances.

The current containment and recirculation sumps contain wire mesh screens with 1/8" x 1/8" square openings. In the evaluation, due to the large debris load, it is assumed that replacement screens having a larger surface area and 1/8" diameter circular openings would be installed. The evaluation uses debris size values from WCAP-16406-P (Ref. 5).

The IR, RHR and HHSI pump vendor is performing an evaluation of the susceptibility of these pumps to blockage and wear and abrasion effects due to the debris concentration determined to be in the recirculating fluid.

Preliminary results of the downstream effects analysis indicate that the majority of components are not susceptible to clogging or undue wear and abrasion including the RHR and HHSI pumps. However, these preliminary results also indicate that the upper and lower bearings of the IR pumps may be affected by debris. Preliminary results also indicate that the fibrous debris that passes through the sump screens may collect to form a thin fiber bed below the core for certain primary system break locations. Resolution of these potential downstream issues may require equipment modifications and/or the use of an alternate evaluation approach as discussed under Alternative Evaluation below.

Chemical Effects

In the replacement recirculation and containment sump screen designs, margin for an increased head loss due to chemical effects will be included. The technical justification for the chemical effects head loss will be based on a plant specific materials evaluation that will determine whether the joint NRC/EPRI integrated chemical effects test (ICET) parameters bound the plant conditions. If the chemical effects test conditions do not bound the plant specific conditions a plant specific evaluation may be required.

Alternate Evaluation

In addition to the evaluations reported above, the application of the methods defined in Section 6.0, "Alternate Evaluation," of Volume 1 of the NEI GR (Ref.1), considering the limitations and clarifications as approved by the NRC SER (Ref. 2), is being considered. This alternate analysis methodology allows for use of an alternate break size in design basis analyses of containment recirculation performance. As part of implementing the alternate evaluation approach, it would be demonstrated that reasonable assurance of mitigation capability is retained for break sizes between the alternate break size and the double-ended guillotine break of the largest pipe in the reactor coolant system.

This alternate analysis is being considered to address challenges associated with the small size of the Unit 2 containment sump as well as to address certain downstream effects currently under evaluation.

Requested Information Item 2(d)

The submittal should include, at a minimum, the following information:

(i) The minimum available NPSH margin for the ECCS and CSS pumps with an unblocked sump screen.

(ii) The submerged area of the sump screen at this time and the percent of submergence of the sump screen (i.e. partial or full) at the time of the switchover to sump recirculation.

(iii) The maximum head loss postulated from debris accumulation on the submerged sump screen, and a description of the primary constituents of the debris bed that result in this head loss. In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) and CSS washdown should be considered in the analyses. Examples of this type of debris are disbonded coatings in the form of chips and particulates and chemical precipitants by chemical reactions in the pool.

(iv) The basis for concluding that the water inventory required to ensure adequate ECCS or CSS recirculation would not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths.

(v) The basis for concluding that inadequate core or containment cooling would not result due to debris blockage at flow restrictions in the ECCS and CSS flowpaths downstream of the sump screen, (e.g., a HPSI throttle valve, pump bearings and seals, fuel assembly inlet debris screen, or containment spray nozzles). The discussion should consider the adequacy of the sump screen's mesh spacing and state the basis for concluding that adverse gaps or breaches are not present on the screen surface.

(vi) Verification that close-tolerance subcomponents in pumps, valves and other ECCS and CSS components are not susceptible to plugging or excessive wear due to extended post-accident operation with debris-laden fluids.

(vii) Verification that the strength of the trash racks is adequate to protect the debris screens from missiles and other large debris. The submittal should also provide verification that the trash racks and sump screens are capable of withstanding the loads imposed by expanding jets, missiles, the accumulation of debris, and pressure differentials caused by post-LOCA blockage under predicted flow conditions.

(viii) If an active approach (e.g., back flushing, powered screens) is selected in lieu of or in addition to a passive approach to mitigate the effects of the debris blockage, describe the approach and associated analyses.

Entergy Response to Item 2(d)(i):

The minimum available NPSH margin for the ECCS and CSS pumps with an unblocked replacement sump screen is dependent upon the replacement sump screen designs. This submittal will be supplemented by December 15, 2005 to include these values upon completion of the design of the replacement sump screens.

Entergy Response to Item 2(d)(ii):

The final design of the replacement sump screens has not been completed. However, it is expected that the final design will result in full submergence of the screens following a large break LOCA. Efforts will be made to ensure full screen submergence following a small break LOCA (SBLOCA). In case of partial screen submergence during a SBLOCA, it is expected that adequate gravity flow through the debris loaded strainer media will be demonstrated. The estimated screen areas of the Unit 2 replacement sump screens are approximately 1800 ft^2 and 1025 ft^2 for the recirculation and containment sumps, respectively. The corresponding Unit 3 strainer areas are 1350 $ft^2$and 800 ft^2. These are the estimated surface areas, utilizing the NUREG-6224 methodology (Ref. 6), to meet debris head loss limits listed in Table 1 without inclusion of chemical effects.

Entergy Response to Item 2(d)(iii):

The maximum calculated head loss across the replacement screens is dependent upon the replacement sump screen designs which as indicated previously have not been finalized. However, for conceptual design purposes, the maximum head loss limits of 0.25 ft and 1.0 ft (for single IR and RHR pump operation, respectively), due to debris accumulation on the submerged sump screens, considered in conjunction with the sump temperature with the most limiting NPSH margin, require approximate screen sizes of 1800 ft^2 and 1025 ft^2 for the Unit 2 recirculation and containment sumps, respectively. The corresponding Unit 3 strainer areas are 1350 $ft^2$and 800 ft^2. These screen sizes should be sufficient to accommodate debris that is transported to the sumps including debris sources that may dislodge and become transportable as a result of the harsh containment environment and effects of containment sprays. Additional sump screen surface area may be required as margin to accommodate the uncertainties associated with chemical effects.

The recirculation sumps at both Unit 2 and Unit 3 and the Unit 3 containment sump are of a sufficient size to accommodate the above noted screen areas plus additional surface area for margins required for chemical effects. The Unit 2 containment sump is considerably smaller, and may not be able to accommodate a 1025 ft^2 screen area.

In order to address the issues associated with the relatively small Unit 2 containment sump, Entergy is currently evaluating analysis, design and licensing basis options. In terms of analysis, consideration is being given to the application of the methods defined in Section 6.0, "Alternate Evaluation," of Volume 1 of the NEI GR (Ref.1) as supplemented by the NRC SER (Ref. 2). The design options under consideration include screen designs that allow higher screen surface areas to be placed within a given volume and possibly extending the sump screens outside of the containment sump. Entergy is also evaluating the feasibility of a containment sump licensing basis change. (See the response to Item 2(e) for further information on licensing basis changes.)

Conceptual designs are under development to reduce the magnitude of debris transported to the sump thereby reducing the required surface area.

The primary constituents of the insulation debris bed that result in screen head loss for Unit 2 are Nukon®, Asbestos, RMI, Temp-Mat and Transco Blanket. The Unit 3 primary constituents are Nukon®, Asbestos, Calcium Silicate, Temp-Mat, Fiberglass, and RMI. Additional debris sources include degraded qualified coatings, qualified coatings within the ZOI, unqualified coatings, latent debris, labels and tags. As indicated in the response to 2(c), screen head loss due to chemical effects is currently in planning.

Entergy Response to Item 2(d)(iv):

The water inventory required for ECCS and CSS recirculation will not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths. This conclusion is based on evaluations and walkdowns conducted to look for potential choke-points in the return flowpaths to the sumps. The liquid inventory holdup evaluations showed acceptable post-LOCA water levels within containment and sufficient flow is provided to the recirculation and containment sumps.

The results of these evaluations were used to establish minimum water levels used in the debris transport and head loss calculations, as well as the conceptual design efforts discussed in this submittal.

Entergy Response to Item 2(d)(v):

As discussed in Response 2(c), the impact of debris passing through the strainers causing blockage in downstream components is currently under evaluation. The purpose of the evaluation is to determine whether the ECCS and portions of the CSS flowpaths could become blocked due to the debris that passes through the containment and recirculation sump screens. The evaluation utilizes the methods described in proprietary WCAP-16406-P (Ref. 5) and vendor evaluations. Both particulate and fibrous debris are considered in the evaluation. A sump screen round hole size of 1/8-inch is currently used as a basis for the evaluation. The replacement sump screen hole size is expected to be 1/8-inch or smaller. Preliminary results of the downstream effects analysis indicate that the majority of components are not susceptible to blockage. However, preliminary results indicate that the upper and lower bearings of the IR pumps and fuel assembly inlet strainers may be adversely affected by the debris/fibrous material that pass through the screens.

The final results of the downstream blockage analysis will be reported to the NRC by December 15, 2005.

Entergy Response to Item 2(d)(vi):

As discussed in Response 2(c), the potential for excessive wear, abrasion, and plugging of close-tolerance subcomponents in pumps, valves and other ECCS and CSS components due to ingestion of debris downstream of the sump screen is under evaluation. The evaluation is using the methods described in proprietary WCAP-16406-P (Ref. 5), vendor evaluations, and an assumed circular sump screen hole size of 1/8-inch.

Preliminary results of the downstream effects analysis indicate that the majority of close-tolerance components are not susceptible to undue wear, abrasion, and plugging including the RHR and HHSI pumps. However, these preliminary results also indicate that the upper and lower bearings of the IR pumps may be adversely affected by debris.

The final results of the downstream wear analysis will be reported to the NRC by December 15, 2005.

Entergy Response to Item 2(d)(vii):

As discussed earlier the structural evaluation of the replacement sump screens and any associated trash racks is dependent upon the replacement sump screen design selected for installation. This evaluation will be performed once a design has been selected and will be consistent with industry accepted practices and applicable regulatory guidance.

Entergy Response to Item 2(d)(viii):

An active approach has not been selected in lieu of a passive approach to mitigate the effects of debris blockage.

Requested Information Item 2(e):

A general description of and planned schedule for any changes to the plant licensing bases resulting from any analyses or plant modifications made to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. Any licensing actions or exemption requests needed to support changes to the plant licensing basis should be included.

Entergy Response to Item 2(e):

Licensing basis changes will be required as a result of analyses and plant modifications made to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of the subject generic letter. Changes to the plant licensing basis will be performed in accordance with 10CFR50.59. Currently, Entergy does not plan to submit License Amendment Requests (LARs) or exemptions requests in conjunction with the resolution of GSI-191 for Indian Point Unit 2 or Unit 3. However, as discussed in the response to 2(d)(iii), licensing basis options associated with the Unit 2 containment sump are under evaluation due to the challenges posed by its small size. Should these evaluations determine that a LAR or exemption request is warranted, such request will be submitted by December 31, 2005.

Requested Information Item 2(f):

A description of the existing or planned programmatic controls that will ensure that potential sources of debris introduced into containment (e.g. insulations, signs, coatings, and foreign materials) will be assessed for potential adverse effects on the ECCS and CSS recirculation functions. Addressees may reference their responses to GL 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating deficiencies and Foreign Material in Containment," to the extent that their responses address these specific foreign material control issues.

Entergy Response to Item 2(f):

Programmatic controls that will be implemented include the additional controls for qualified coatings, an insulation configuration control and inspection program and revised FME controls.

A qualified coatings program will be added to the controls already in place for the procurement, application, maintenance and assessment of qualified coatings. The inspection process currently includes a detailed visual inspection and documentation of coating status and deficiencies. The visual inspection will be augmented by the qualified coatings program.

The insulation configuration control program will be used to ensure that future potential sources of insulation debris will be controlled with respect to potential effects. The program will provide controls to maintain the inventory of insulation inside of containment such that the amount and type remains within the acceptable design margin for debris loading of the recirculation and containment sump suction strainers following a LOCA.

The revised containment FME program will ensure the containment FME programs will not introduce foreign materials that would adversely affect the ECCS and CSS recirculation functions. This program will also monitor the level of dirt/dust and latent fiber within the containment building.

References

1. Nuclear Energy Institute Document NEI 04-07, Volume 1, Revision 0, "Pressurized-Water Reactor (PWR) Sump Performance Methodology," dated December, 2004.

2. Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02, published as Volume 2 of Nuclear Energy Institute Guidance Report (NEI 04-07) "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December, 2004.

3. Nuclear Energy Institute Report NEI 02-01, "Condition Assessment Guidelines: Debris Sources Inside PWR Containments," Revision 1, dated September, 2002.

4. Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-Of-Coolant Accident," Revision 3, November 2003.

5. WCAP-16406-P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," June 2005.

6. NUREG/CR-6224, "Parametric Study of the Potential for BWR ECCS Strainer Blockage Due to LOCA Generated Debris," dated October 1995.

Table 1 Allowable Strainer Debris Head Loss

Sump	Pump Alignment	Allowable Debris Head Loss
Recirculation	One internal recirculation pump	0.25 ft
Recirculation	Two internal recirculation pumps	1.5 ft
Containment	One RHR pump	1.0 ft

INDIAN POINT UNIT 2 and UNIT 3

ATTACHMENT 2 TO NL-05-094

Update to Commitments made in the 90-Day Response to NRC Generic Letter 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors

ENTERGY NUCLEAR OPERATIONS, INC
INDIAN POINT NUCLEAR GENERATING UNITS 2 AND 3
DOCKETS 50-247 AND 50-286

Number	Commitment	Due Date
1	Complete Indian Point Unit 3 containment walkdowns to support the analysis of susceptibility of the ECCS and CSS recirculation functions to the adverse effects of debris blockage identified in Generic Letter 2004-02.	Complete
2	Complete the analyses of the susceptibility of the ECCS and CSS recirculation functions for Indian Point Unit 2 and Unit 3 to the adverse effects of post accident debris blockage and operation with debris-laden fluids identified in Generic Letter 2004-02.	Prior to 2R17 and 3R14